

MLX90820

Absolute Integrated Pressure Sensor

1. Features and Benefits

- Fully integrated IC (MEMS, analog front-end, 16-bit microcontroller, analog back-end, voltage regulators, SENT driver)
- Protected against oil charges
- Programmable through connector
- Built-in EE memory protection
- Automotive temperature -40°C to 150°C
- Analog Ratiometric and SENT outputs
- Automotive diagnostic features
 - Clamping levels
 - Broken track diagnostics
 - Multiple internal fault diagnostics
- High accuracy
- Robust EMC performance
- Mid-pressure range 10..50 bar

2. Application Examples

- Mid pressure ranges (10..50bar)
- HVAC/refrigeration
- Industrial oil filled pressure sensor modules

3. Description

The MLX90820 is an integrated absolute pressure sensor delivering a ratiometric analog or digital (using the SENT protocol) signal. MLX90820 is the ideal solution for pressure sensor applications requiring high accuracy, high EMC robustness and miniaturization.

Use of an optimized architecture and a high density CMOS technology imparts the MLX90820 with best in class automotive EMC performance. A DSP based architecture using a 16bit microcontroller provides outstanding performance in terms of initial accuracy.

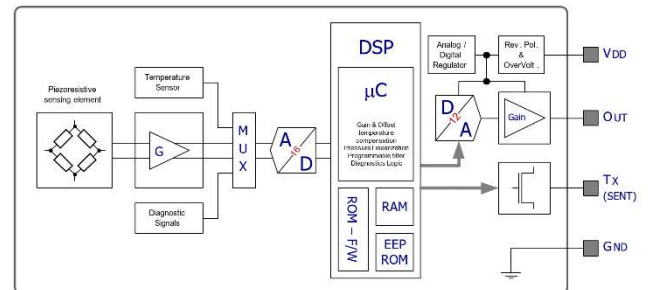
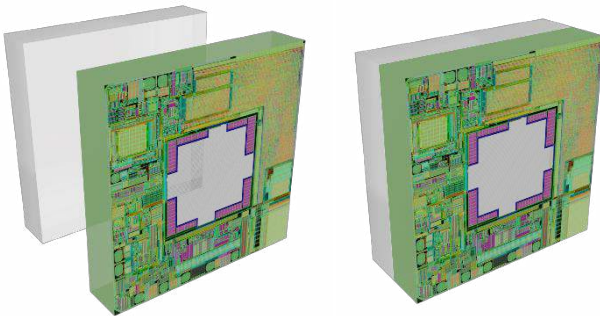


Figure 1: Block diagram

MLX90820

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4. Ordering Information

Product	Temperature	Package	Option Code	Packing Form	Definition
MLX90820	L (-40°C to 150°C)	UF	EBA-000	WB	10 to 35 bar range with electronic wafer map
MLX90820	L (-40°C to 150°C)	UF	EBB-000	WB	30 to 50 bar range with electronic wafer map

Table 1: Ordering information

Legend:

Temperature Code:	L: from -40°C to 150°C
Package Code:	“UF” for saw wafer on foil
Option Code:	EBA-000: 10 to 35 bar application range with electronic wafer map EBB-000: 30 to 50 bar application range with electronic wafer map
Packing Form:	“WB” for wafer box
Ordering Example:	“MLX90820LUF-EBA-000-WB” For a sensor covering 10 to 35 bar pressure span in the application delivered as a saw wafer on foil with an electronic wafer map.

5. Functional Diagram

The pressure sensing element consists of a square diaphragm realized in the silicon chip by backside etching. The diaphragm reacts to a pressure difference between the top and vacuum reference on the bottom side of the diaphragm. The internal strain increases, in particular at the border of the diaphragm. Here, the piezo-resistive elements have been implanted into the silicon diaphragm, which act as a transducer.

The electronics front end amplifies the signal from the bridge, performs a coarse offset compensation and an ADC conversion. The DSP performs the compensations over temperature. Furthermore, the digital circuit provides some filtering, the possibility to linearize the pressure signal and also implements the clamping function. The analog back end consists of a 12 bit DAC and an output driver. This chip delivers an analog output proportional to the pressure or a SENT output compliant with SAE J2716 spec dated January 2010.

A broken wire detection block allows actively driving the output to one of the rails in case of a broken supply or ground connection. Extensive protection of the supply lines allows the MLX90820 to handle extreme overvoltage conditions and is immune to severe external disturbances. Several diagnostic functions (over-voltage, under-voltage, overpressure, under pressure detections) have been implemented on the MLX90820 and can be enabled by programming EEPROM settings. Figure 2 describes MLX90820 block diagram.

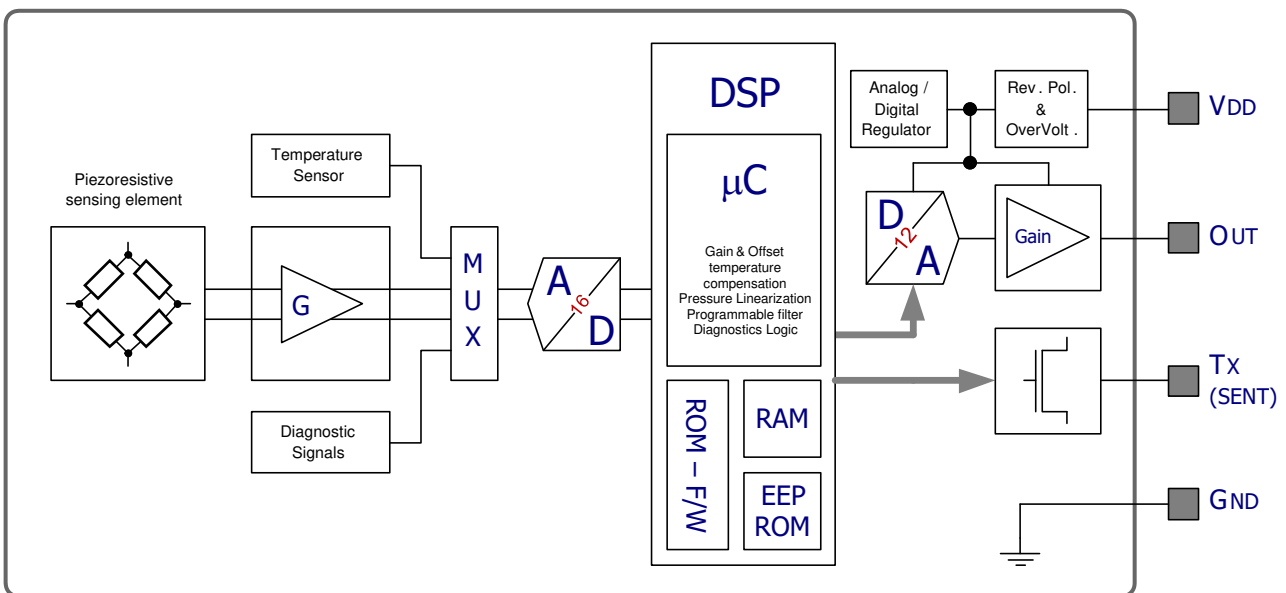


Figure 2: MLX90820 block diagram

6. Glossary of Terms

Bar	Pressure unit (1bar = 100kPa)
ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
DSP	Digital Signal Processor
EMC	Electro Magnetic Compatibility
FSO	Full Span Output
SENT	Single Edge Nibble Transmission

Table 2: Glossary of terms

7. Bond Pads Location and Description

The positions of the bond pads are shown in Figure 3. The (X, Y) axes are depicted in blue; they represent the basis of the Cartesian coordinates of the bond pads center points.

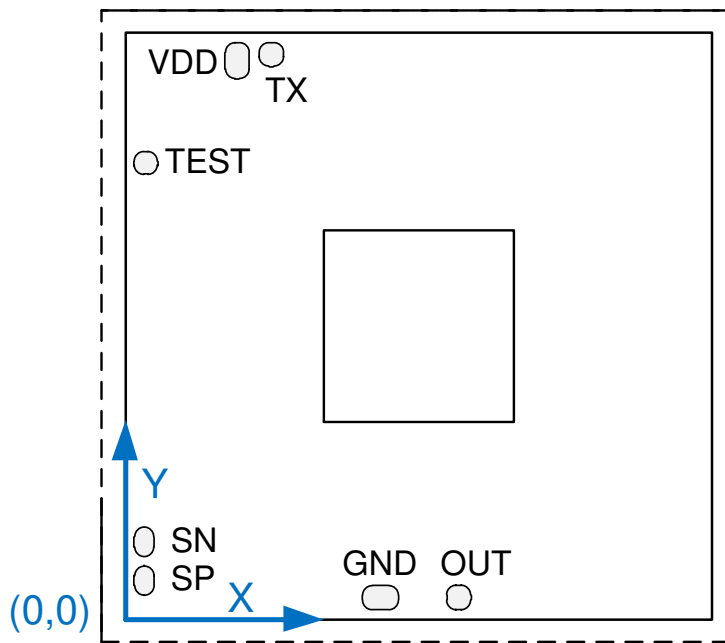


Figure 3: Bond pads location

The bond pad coordinates and their names and functional type are given in table 3.

Pin	Type	Coordinates ⁽¹⁾		Pad Opening		Comment
		X	Y	X, Y	X, Y	
VDD	Supply	470	2345	100	150	
TX	Output	612	2370	100	100	To be connected in SENT mode
TEST	Input	86	1914	95	95	Do Not Connect
SN	Output	80	325	80	120	Do Not Connect
SP	Output	80	163	80	120	Do Not Connect
GND	Ground	1070	91	150	100	
OUT	Output	1397	91	100	100	To be connected in Analog Mode

Table 3: Bond pad coordinates

8. Absolute Maximum Ratings

Parameter	Symbol	Max.	Unit
Supply Voltage ⁽²⁾	V _{DD}	+18	V
Reverse Supply Voltage ⁽³⁾	V _{DDREV}	-14	V
Positive Output Voltage ⁽²⁾		+18	V
Reverse Output Voltage ⁽²⁾		-0.5	V
Operating Temperature Range		-40 to 150	°C
Storage Temperature Range		-40 to 150	°C
Burst Pressure @ Room Temperature For EBA For EBB	P _{BURST}	105 140	Bar
Proof Pressure @ Room Temperature For EBA For EBB	P _{PROOF}	70 105	Bar

Table 4: Absolute maximum ratings

Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

¹ Coordinate of the center of the pad.

² No time limit or temperature limit for these over voltage conditions

³ Reverse Voltage Protection at -14V at 150 °C for maximum 1 hour. At Room Temperature that condition can apply for maximum 24 hours

9. General Electrical Specifications

DC operating parameters T = -40°C to 150°C, V_{DD} = 5V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ ⁽⁴⁾	Max	Units
Nominal Supply Voltage	V _{DD}		4.5	5	5.5	V
Nominal Supply Current	I _{DD}	No output load connected		7	8	mA
Analog Output Load (Resistive)	R _{LOAD}	Pull-up or Pull-down	4.7			kΩ
Analog Output Load (Capacitive)	C _{LOAD}		2.2		470	nF
SENT Output Load (Capacitive)	C _{LOAD}				2.2	nF
SENT Output Load (C-R-C)	CRC _{LOAD}				1.1nF + 220Ω + 1.1nF	
Diagnostic Limits	diag_lo	Pull-up ≥ 4.7kΩ Pull-down ≥ 4.7kΩ			3 3	%V _{DD}
	diag_hi	Pull-up ≥ 4.7kΩ Pull-down ≥ 8kΩ	96 96			%V _{DD}
Clamping Levels ⁽⁵⁾	clamp_lo		0		25	%V _{DD}
	clamp_hi		50		100	%V _{DD}
Analog Saturation Output Level	vsat_lo	Pull-up ≥ 4.7kΩ Pull-down ≥ 4.7kΩ	0 0		3 3	%V _{DD}
	vsat_hi	Pull-up ≥ 4.7kΩ Pull-down ≥ 4.7kΩ Pull-down ≥ 10kΩ	97 96 97		100 100 100	%V _{DD}
Power Up Time ⁽⁶⁾					5.5	ms
Response Time ⁽⁷⁾ Analog Output					1	ms
Response Time SENT Output		3μs tick time, pause pulse enabled		3	4	frames
Ratiometricity Error					0.2	%V _{DD}
Analog Output Noise ⁽⁸⁾					2	mV _{rms}
SENT Output Noise ⁽⁸⁾					1.8	LSB _{rms}
Internal Temperature Error on SENT Output	T _{PTAT}	0 hours	-5		5	°C
		Over life	-10		10	

Table 5: General electrical specification

⁴Typical values are defined at T_A = +25°C and V_{DD} = 5V

⁵ Programmable range with 8 bits resolution for the low clamping level and 9 bits resolution for the high clamping level (See application note 90809 Advanced Configuration Settings for detailed information)

⁶ Time from reaching the minimum allowed supply voltage of 4.5V till having the output within specification

⁷ Time needed for the output to react to a pressure change from 10% to 90% of its final value (pressure change corresponding to maximum a 4V output change) using default filter settings SSF=1, PFLT = 0 (See application note 90809 Advanced Configuration Settings for detailed information)

⁸ Bandwidth limited to 50kHz. Using default filter settings SSF = 1, PFLT = 0.

10. Pressure Accuracy Specifications

DC operating parameters T = -40°C to 150°C, V_{DD} = 5V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Max	Units
Non Linearity Error ⁽⁹⁾		<u>EBA</u> Room Temperature 10 bar (2 point calibration) 35 bar (2 point calibration)		0.1 0.2	%FSO
		<u>EBB</u> Room Temperature 30 bar (2 point calibration) 50 bar (2 point calibration)		0.1 0.2	%FSO
Hysteresis			-0.25	0.25	%FSO
Programmable Pressure Spans		EBA	10	35	Bar
		EBB	30	50	
Overall Accuracy ⁽¹⁰⁾			-2.5	2.5	%FSO

Table 6: Pressure accuracy specification

11. Application Information

The MLX90820 only needs 2 capacitors in the application as minimum requirements, a 47nF decoupling capacitor on the supply line and a 47nF load on the analog output pin. When the SENT output is used a 2.2nF capacitor is recommended. Consult Melexis to discuss the ideal application schematics depending on the EMC specs to be fulfilled.

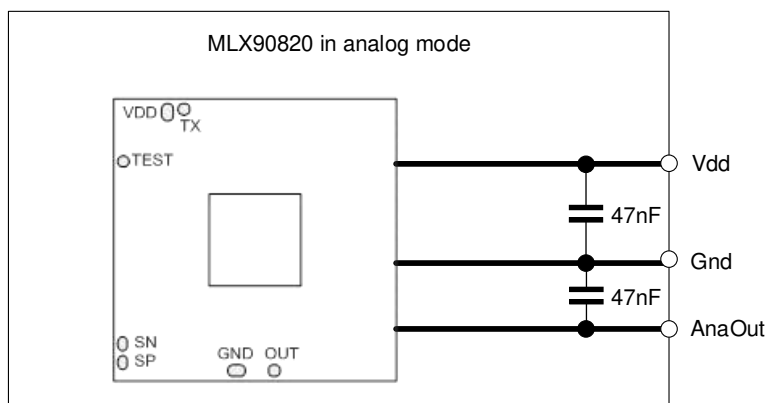


Figure 4: MLX90820 application schematic - analog

⁹ Best Fit Non Linearity using ceramics prototype package.

¹⁰ Indicative overall accuracy using ceramics prototype package and calibration in engineering setup of EBA at 20bar and EBB at 50bar.

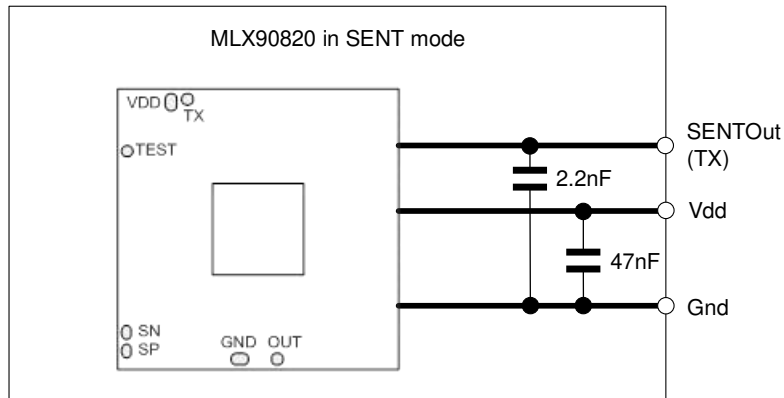


Figure 5: MLX90820 application schematic - SENT

12. Die Dimensions

The MLX90820 shall be delivered as bare die, on fully tested wafers. Each wafer is accompanied by a wafer map in order to discriminate between good and bad dies during customer assembly. The die dimensions (including scribe lane), membrane size are depicted in Figure 6. All dimensions are in mm.

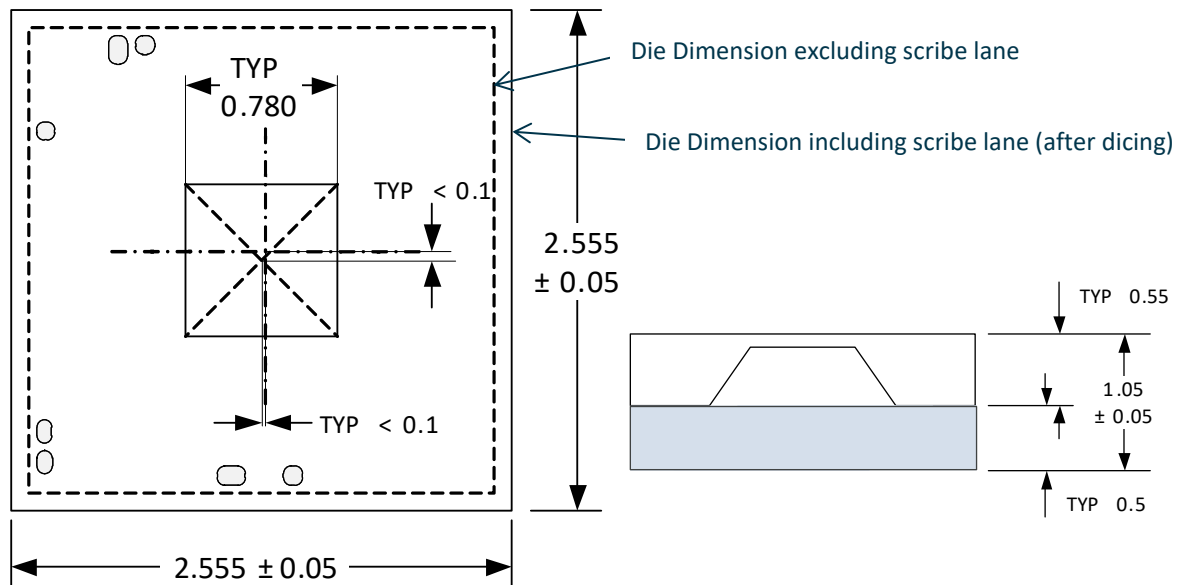


Figure 6: Floorplan of a single die, including central position of membrane

13. Standard Information

Our products are classified and qualified regarding soldering technology, solderability and moisture sensitivity level according to standards in place in Semiconductor industry.

For further details about test method references and for compliance verification of selected soldering method for product integration, Melexis recommends reviewing on our web site the General Guidelines [soldering recommendation](#). For all soldering technologies deviating from the one mentioned in above document (regarding peak temperature, temperature gradient, temperature profile etc), additional classification and qualification tests have to be agreed upon with Melexis.

For package technology embedding trim and form post-delivery capability, Melexis recommends to consult the dedicated trim&form recommendation application note: [lead trimming and forming recommendations](#)

Melexis is contributing to global environmental conservation by promoting **lead free** solutions. For more information on qualifications of **RoHS** compliant products (RoHS = European directive on the Restriction Of the use of certain Hazardous Substances) please visit the quality page on our website: <http://www.melexis.com/en/quality-environment>

14. ESD Precautions

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